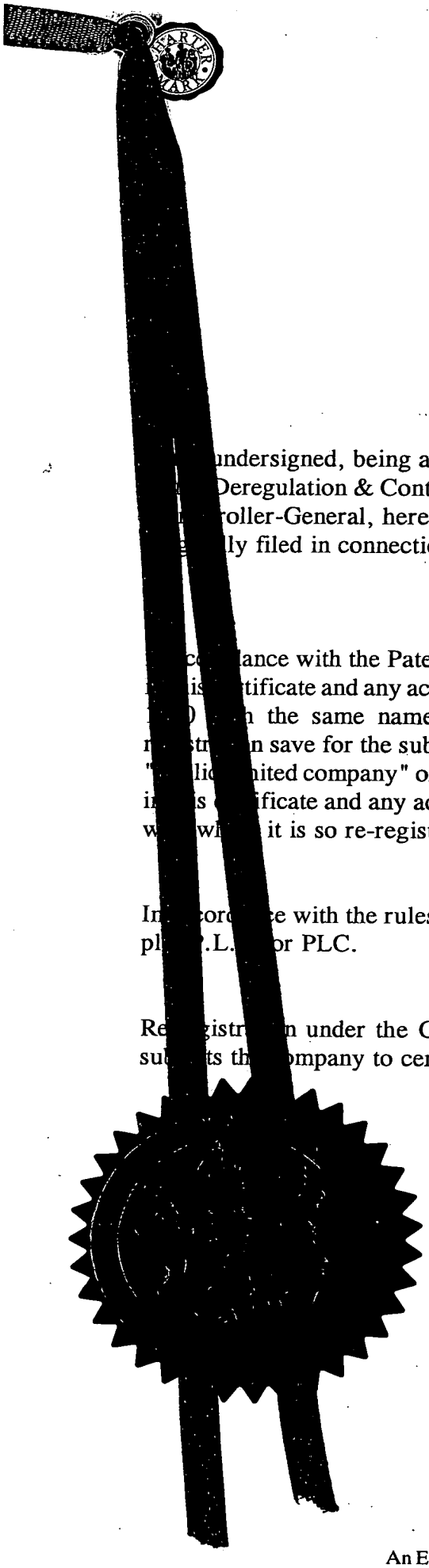

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Ceramaspeed Limited
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Oldington
Kidderminster
Worcestershire DY11 7DY

4428439002

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

~~United Kingdom~~

4. Title of the invention

RADIANT ELECTRIC HEATER

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

DEREK JACKSON ASSOCIATES

The Old Yard, Lower Town
Claines
Worcester WR3 7RY

5600416002

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RADIANT ELECTRIC HEATER

This invention relates to a radiant electric heater and in particular relates to a radiant electric heater, for example for a glass ceramic cooking appliance, comprising at least first and second adjacent heating zones.

It is known to manufacture radiant electric heaters for glass ceramic top cooking appliances which are provided with two heating zones in the form of an inner, circular, heating zone and an outer, annular, heating zone extending around the inner zone. The inner and outer heating zones may, or may not, be separated by a dividing wall of thermal insulating material so as to define if desired separate and distinct heating zones on the glass ceramic cooking surface. The inner and outer heating zones are each constituted by a heating element in the form of a ribbon or coil material which is configured to occupy the space allotted to the heating zone concerned and which is supported on a base of thermal insulating material provided in a supporting dish. Thus, a first heating element is provided in the inner heating zone and a second heating element is provided in the outer heating zone. A probe-type temperature sensor or other suitable type of temperature sensor extends over the outer and inner heating zones and is adapted to be responsive in particular to the

temperature of the glass ceramic cooking surface in the region of the inner heating zone. The heating elements are connected to the temperature sensor and to a source of electrical power by way of a terminal block provided in a peripheral wall of the supporting dish. The terminal block is provided adjacent to the temperature sensor and is formed with three electrical connectors which extend substantially radially relative to the supporting dish, a first connector adjacent to the temperature sensor, a second connector remote from the temperature sensor and a third connector intermediate the first and second connectors. It is common practice in such known heaters to connect the first connector externally of the supporting dish directly to an electrical connector of the temperature sensor, for example by means of welding, and internally of the dish to one end of each of the first and second heating elements. It is also common practice to connect the other end of the second heating element to the second connector within the dish and to connect the other end of the first heating element to the third connector within the dish, the connection between the end of the first heating element and the third connector being by way of a link which is secured at one end to the end of the first heating element, passes over the end of the second heating element, and is connected to, or integral with, the third connector.

Disadvantages of such known radiant electric heaters are that the presence of two separate heating elements and the manner in which the heating elements are secured to the electrical connectors render the insertion of the heating elements unsuitable for automatic production methods.

Similar problems can arise with oval radiant electric heaters in which a second heating element is provided adjacent to a first heating element, the first heating element being provided in a circular heating zone and the second heating element being provided in a part-circular, substantially arcuate (or crescent shaped) heating zone.

It is therefore an object of the present invention to provide a radiant electric heater which overcomes or at least ameliorates the above disadvantages.

According to the present invention there is provided a radiant electric heater comprising at least first and second adjacent heating zones, the first heating zone including a first heating element and the second heating zone including a second heating element, and terminal means provided at a periphery of the heater for connecting the first and second heating elements to a source of electrical energy, wherein the heating elements are integral with conjoined ends connected to a first electrical connector,

with one free end connected to a second electrical connector, and with another free end connected to a third electrical connector, the first, second and third electrical connectors including means for connecting to the heating elements in such a way that the heating elements are not deflected from their intended path to any substantial extent.

The heating elements may be in the form of a ribbon inserted upright into a base of thermal and electrical insulating material.

The first heating zone may be circular. In such a case, the second heating zone may be annular and may surround the first heating zone or the second heating zone may be part-circular and may partially surround the first heating zone.

A peripheral wall may be provided around the external periphery of the heater.

A dividing wall may be provided between the adjacent heating zones.

A temperature limiter may be provided for sensing the temperature in the region of at least the first heating zone.

The third electrical connector may be positioned intermediate the first and second electrical connectors.

In such a case, a radially inner region of each of the first and second electrical connectors may extend generally circumferentially of the heater in a direction away from the terminal block. The radially inner region of the first electrical connector may extend at an angle in a range from 70 degrees to 90 degrees, for example substantially at 80 degrees, to a portion thereof passing through the terminal block. The radially inner portion of the second electrical connector may extend at an angle in a range from 30 degrees to 60 degrees, for example substantially at 45 degrees, to a portion thereof passing through the terminal block.

A radially inner region of the third electrical connector may extend generally circumferentially of the heater in a direction towards one of the first and second electrical connectors. The radially inner portion of the third electrical connector may include a link element which passes across the region of the conjoined ends of the first and second heating elements. The link element may pass over the region of the conjoined ends of the first and second heating elements. Alternatively, the link element may pass under the region of the conjoined ends of the first and second heating elements. The radially inner

portion of the second electrical connector may extend at an angle in a range from 30 degrees to 60 degrees, for example substantially at 45 degrees, to a portion thereof passing through the terminal block.

Alternatively, a radially inner region of the second electrical connector may extend generally circumferentially of the heater in a direction away from the terminal block. The radially inner portion of the second electrical connector may extend at an angle in a range from 30 degrees to 60 degrees, for example substantially at 45 degrees, to a portion thereof passing through the terminal block. The radially inner portion of the third electrical connector may include a link element which passes across the second heating element. The radially inner portion of the first electrical connector may include a link element which passes across the second heating element.

In an alternative embodiment, the first electrical connector is positioned intermediate the second and third electrical connectors. A radially inner region of each of the second and third electrical connectors may extend generally circumferentially of the heater in a direction away from the terminal block. The radially inner portion of the second electrical connector may extend at an angle in a range from 30 degrees to 60 degrees, for example

substantially at 45 degrees, to a portion thereof passing through the terminal block. The radially inner portion of the third electrical connector may extend at an angle in a range from 30 degrees to 60 degrees, for example substantially at 45 degrees, to a portion thereof passing through the terminal block. A radially inner region of the first electrical connector may extend generally circumferentially of the heater in a direction towards one of the second and third electrical connectors. The radially inner region of the first electrical connector may extend at an angle in a range from 70 degrees to 90 degrees, for example substantially at 80 degrees, to a portion thereof passing through the terminal block.

For a better understanding of the present invention and to show more clearly how it may be carried into effect reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 is a perspective view, from above, of one embodiment of a radiant electric heater according to the present invention;

Figure 2 is a view similar to that of Figure 1 with a peripheral wall of the radiant electric heater removed;

Figure 3 is a view, on a larger scale, of part of the radiant electric heater shown in Figure 2, but with a temperature limiter of the radiant electric heater additionally removed; and

Figure 4 is a plan view of another embodiment of a radiant electric heater according to the present invention.

The radiant electric heater shown in Figures 1 to 3 comprises a supporting dish 1, for example of metal, containing a base 3 of thermal and electrical insulating material, for example compressed microporous thermal and electrical insulating material. Secured to the base 3 is a first heating element 5 of ribbon form material inserted upright into the base, the first heating element 5 occupying a substantially circular inner heating zone 7 in the central region of the heater. Also secured to the base 3 is a second heating element 9 of ribbon form material inserted upright into the base, the second heating element 9 occupying a substantially annular outer heating zone 11 around the peripheral region of the heater. The first and second heating elements are integral and each has a free end and a conjoined end integral with a conjoined end of the other heating element.

In practice, the first heating element 5 is arranged to be energised whenever the heater is energised irrespective of the size of the cooking utensil placed on a glass ceramic cooking surface (not shown) below which the heater is arranged, while the second heating element 9 is only energised (in conjunction with the first heating element) when a relatively large cooking utensil is used such that the cooking utensil overlies both the first and second heating elements.

A peripheral wall 13 of thermal insulating material extends around the periphery of the heater between the outer heating zone 11 and an upstanding wall of the supporting dish 1.

A probe-type temperature limiter 15 extends from a periphery of the heater, a temperature sensor 17 of the limiter 15 extending substantially over the first heating element 5 in the inner heating zone 7. As shown in Figures 1 to 3, the end regions 5A and 5B of the first heating element 5 extend beneath the temperature sensor 17 where the temperature sensor crosses the outer heating zone 11 in order to reduce as far as practicable the effect of the second heating element on the temperature sensed by the temperature sensor 17 and to minimise as far as practicable the change in the temperature of the glass ceramic cooking

surface resulting from when only the first heating element or both the first and second heating elements are energised.

A terminal block 19 is mounted on the upstanding wall of the supporting dish 1 adjacent to the temperature limiter 15 and is provided with a first electrical connector 21 adjacent to the temperature limiter, a second electrical connector 23 remote from the temperature limiter and with a third electrical connector 25 intermediate the first and second electrical connectors.

Externally of the supporting dish 1, the first electrical connector 21 is connected directly, for example by welding, to an electrical connector of the temperature limiter 15.

Internally of the supporting dish 1 and the peripheral wall 13, the first electrical connector 21 is bent so as to extend substantially parallel to the circumference of the heater in a direction towards the temperature limiter 15, that is in a direction away from the terminal block 19. For example, the internal portion 21A of the first electrical connector 21 may be bent at an angle of substantially 80 degrees to that part of the connector which passes through the terminal block. Such a substantially circumferential arrangement of the internal

portion 21A of the first electrical connector 21 allows the conjoined ends of the first heating element 5 and the second heating element 9 to be arranged adjacent and substantially parallel to a radially inner face of the portion 21A. Such an arrangement allows the end portions of the first and second heating elements to be integral as described above and to be secured to the portion 21A of the first electrical connector 21, for example by means of welding, so as to form a common connection for the conjoined ends of the first and second heating elements. Thus, as indicated above, the first and second heating elements may be integral and may be a single heating element. Thus, only a single heating element needs to be inserted into the base 3 thereby facilitating automatic insertion of the heating elements by "winding in" the heating elements from the free end of the first heating element remote from the conjoined ends of the first and second heating elements to the free end of the second heating element also remote from the conjoined ends. Further, in the region where the conjoined ends of the first and second heating elements are secured to the portion 21A of the first electrical connector 21, the conjoined ends are able to extend substantially circumferentially and do not need to be deflected to any substantial extent from their intended path, thereby avoiding small radius bends and further facilitating

automatic insertion of the integral first and second heating elements.

Internally of the supporting dish 1 and the peripheral wall 13, the second electrical connector 23 is bent so as to be angled generally circumferentially of the heater in a direction away from the temperature limiter 15, that is in a direction away from the terminal block 19. For example, the internal portion 23A of the second electrical connector may be bent at an angle of substantially 45 degrees to that part of the connector which passes through the terminal block 19. Such an angled arrangement of the internal portion 23A of the second electrical connector 23 allows the free end of the second heating element 9 to be arranged adjacent and substantially parallel to a radially inner face of the portion 23A. Such an arrangement allows the free end portion of the second heating element to be secured to the portion 23A of the second electrical connector 23, for example by means of welding, so as to form a second connection for the second heating element 9 without the need for the heating element to be deflected to any substantial extent from its intended path.

Internally of the supporting dish 1 and the peripheral wall 13, the third electrical connector 25 is bent so as to be angled generally circumferentially of the heater in a

direction away from the temperature limiter 15, that is in a direction towards the second electrical connector 23. For example, the internal portion 25A of the third electrical connector may be bent at an angle of substantially 45 degrees to that part of the connector which passes through the terminal block 19. Such an angled arrangement of the internal portion 25A of the third electrical connector 25 allows the third electrical connector to include a link element 27 to be secured to, or formed integral with, the remainder of the internal portion 25A of the third electrical connector 25, the link element extending substantially at right angles to the remainder of the portion 25A and having a generally U-shaped configuration so as to extend over (or under) the conjoined ends of the first and second heating elements and to allow the free end of the first heating element 5 to be arranged adjacent and substantially parallel to a radially inner substantially upright face of the link element 27 which extends generally circumferentially of the heater. Such an arrangement allows the free end portion of the first heating element 5 to be secured to the link element 27, for example by means of welding, and thus to the remainder of the portion 25A of the third electrical connector 25 so as to form a second connection for the first heating element 5 without the need for the heating element to be deflected to any substantial extent from its intended path.

As can be seen from Figures 1 to 3, the internal portions of the electrical connectors at each circumferential end of the terminal block 19 extend generally circumferentially away from the terminal block, while the internal portion of the intermediate electrical connector may extend generally circumferentially towards whichever of the other two electrical connectors is most convenient. Such an arrangement allows the integral first and second heating elements to be inserted into the base while providing gentle bends with relatively large radii in the regions of the electrical connectors such that the heating elements do not need to be deflected to any substantial extent from their intended path.

Thus, the heating elements may be inserted into the base 3 of the radiant electric heater shown in Figures 1 to 3 by starting at a free end of one of the heating elements and continuing until the free end of the other heating element is reached. In this way, both heating elements can be inserted into the base in a single operation, the gentle bends, particularly in the regions of the internal portions of the connectors, facilitating automatic insertion and the arrangements of the internal portions facilitating securement of the heating elements to the internal portions of the connectors.

In use of the radiant electric heater shown in Figures 1 to 3, either the first heating element 5 can be energised alone, or the first and second heating elements 5 and 9 can be energised in parallel.

The radiant electric heater shown in Figures 1 to 3 can be modified in a number of respects. For example, the radiant electric heater need not be circular, but could be, for example, oval in configuration with the first heating element 5 occupying a substantially circular heating zone 7 and the second heating element 9 occupying a part-circular (or crescent shaped) heating zone 11 adjacent to the circular heating zone 7.

Moreover, although the two heating zones are shown in Figures 1 to 3 as being undivided, if desired a dividing wall may be provided in a manner well known to the skilled person between the two heating zones so as to define on the glass ceramic cooking surface separate and distinct heating areas corresponding to the two heating zones.

Should it not be necessary to provide the first electrical connector at one end of the terminal block 19 for direct connection to the temperature limiter 15, and providing there is adequate space along the circumferential length of the terminal block, the first electrical connector for the

conjoined ends of the integral first and second heating elements may be provided intermediate the second and third electrical connectors, with the internal portion of the first electrical connector extending in a generally circumferential direction towards whichever of the other two electrical connectors is most convenient. Such an arrangement has the advantage that the link 27 is no longer required and the free end of the first heating element can be secured directly to the internal portion of the third electrical connector, such internal portion being bent in a direction generally circumferentially of the heater away from the terminal block 19, for example at an angle of about 45 degrees to that part of the third electrical connector which passes through the terminal block, to allow the free end of the first heating element 5 to be arranged adjacent and substantially parallel to a radially inner face of the portion 25A. Such an arrangement allows the free end portion of the first heating element to be secured to the portion 25A of the third electrical connector 25, for example by means of welding, so as to form a second connection for the first heating element 5.

Thus, the internal portions of the electrical connectors at each circumferential end of the terminal block 19 extend generally circumferentially away from the terminal block, while the internal portion of the intermediate electrical

connector may extend generally circumferentially towards whichever of the other two electrical connectors is most convenient.

Where the radiant electric heater in Figures 1 to 3 shows the internal portion 21A of the first electrical connector 21 angled in a direction opposite to the internal portion 23A of the second electrical connector 23 it should be appreciated that all the internal portions 21A, 23A and 25A could be angled in the same direction relative to the terminal block 19. In which case the internal portion 21A of the first electrical connector 21 would be bent at an angle in the range from 30 degrees to 60 degrees, for example substantially at 45 degrees, to that part of the connector which passes through the terminal block.

The radiant electric heater shown in Figure 4 is similar to that shown in Figures 1 to 3 and the same reference numerals are used to denote the same or similar components. The radiant electric heater of Figure 4 is shown with the peripheral wall 13 omitted, but with the temperature limiter 15 present.

As can be seen from Figure 4, the second heating element 9 is wound in from the periphery of the outer heating zone 11 to the junction between the outer and inner heating zones.

The integral first heating element 5 is then wound in from the periphery of the inner heating zone 7 to the region of the centre of the heater and is then wound in from the region of the centre of the heater back to the periphery of the inner heating zone 7.

The free end of the second heating element 9 is connected to the internal portion 23A of the second electrical terminal 23 of the terminal block 19, the internal portion 23A being bent so as to be angled in a direction generally circumferentially of the heater away from the temperature limiter 15, that is in a direction away from the terminal block 19. For example, the internal portion 23A of the second electrical connector may be bent at an angle of substantially 45 degrees to that part of the connector which passes through the terminal block. Such an angled arrangement of the internal portion 23A of the second electrical connector 23 allows the free end of the second heating element 9 to be arranged adjacent and substantially parallel to a radially inner face of the portion 23A. Such an arrangement allows the end portion of the second heating element to be secured to the portion 23A of the second electrical connector 23, for example by means of welding, so as to form a connection for the second heating element 9 without the need for the heating element to be deflected to any substantial extent from its intended path.

The third electrical connector 25 includes link element 27 between the free end of the first heating element 5 and the remainder of the internal portion 25A of the third electrical connector 25 and extending over (or under) the second heating element 9. In the embodiment of Figure 4 it is not necessary for the internal portion of the third electrical connector to be bent relative to that part which passes through the terminal block. However, the radially inner end of the link element 27 is formed with a generally circumferential upright face to allow the free end portion of the first heating element 5 to be secured to the link element 27, for example by means of welding, and thus to the remainder of the portion 25A of the third electrical connector 25 so as to form a connection for the first heating element 5 without the need for the free end of the first heating element to be deflected to any substantial extent from its intended path.

The first electrical connector 21 includes a further link element 29 provided between the conjoined ends of the integral first and second heating elements and the remainder of the internal portion 21A of the first electrical connector 21 and extending over (or under) the second heating element 9. As with the third electrical connector 25, it is not necessary for the internal portion of the electrical connector to be bent relative to that

part which passes through the terminal block 19. However, the radially inner end of the further link element 29 is formed with a generally circumferential upright face to allow the conjoined end portions of the first and second heating elements to be secured to the further link element 29, for example by means of welding, and thus to the remainder of the portion 21A of the first electrical connector 21 so as to form a connection for the conjoined ends of the first and second heating elements 5 and 9 without the need for the conjoined ends of the first and second heating elements to be deflected to any substantial extent from their intended path.

If desired, the temperature sensor 17 of the temperature limiter 15 can be rendered insensitive to heat emitted by the second heating element in any one of a number of ways well known to the skilled person.

If desired, the radiant electric heater of Figure 4 may be modified to provide more than two heating zones, each heating zone having a heating element. In such a case, the terminal block requires an electrical connector for each of the two free ends and an electrical connector for each of the conjoined ends between successive heating elements. Thus, a radiant electric heater with three heating zones will require a terminal block with four electrical

connectors, one for each of the free ends, one for a connection between the first and second zones and one for a connection between the second and third zones.

CLAIMS

1. A radiant electric heater comprising at least first and second adjacent heating zones, the first heating zone including a first heating element and the second heating zone including a second heating element, and terminal means provided at a periphery of the heater for connecting the first and second heating elements to a source of electrical energy, wherein the heating elements are integral with conjoined ends connected to a first electrical connector, with one free end connected to a second electrical connector, and with another free end connected to a third electrical connector, the first, second and third electrical connectors including means for connecting to the heating elements in such a way that the heating elements are not deflected from their intended path to any substantial extent.

2. A heater as claimed in claim 1, wherein the heating elements are in the form of a ribbon inserted upright into a base of thermal and electrical insulating material.

3. A heater as claimed in claim 1 or 2, wherein the first heating zone is circular.

4. A heater as claimed in claim 3, wherein the second heating zone is annular and surrounds the first heating zone.

5. A heater as claimed in claim 3, wherein the second heating zone is part-circular and partially surrounds the first heating zone.

6. A heater as claimed in any preceding claim, wherein a peripheral wall is provided around the external periphery of the heater.

7. A heater as claimed in any preceding claim, wherein a dividing wall is provided between the adjacent heating zones.

8. A heater as claimed in any preceding claim, wherein a temperature limiter is provided for sensing the temperature in the region of at least the first heating zone.

9. A heater as claimed in any preceding claim, wherein the third electrical connector is positioned intermediate the first and second electrical connectors.

10. A heater as claimed in claim 9, wherein a radially inner region of each of the first and second electrical

connectors extends generally circumferentially of the heater in a direction away from the terminal block.

11. A heater as claimed in claim 10, wherein the radially inner region of the first electrical connector extends substantially at 80 degrees to a portion thereof passing through the terminal block.

12. A heater as claimed in claim 10 or 11, wherein the radially inner portion of the second electrical connector extends substantially at 45 degrees to a portion thereof passing through the terminal block.

13. A heater as claimed in any one of claims 9 to 12, wherein a radially inner region of the third electrical connector extends generally circumferentially of the heater in a direction towards one of the first and second electrical connectors.

14. A heater as claimed in claim 13, wherein the radially inner portion of the third electrical connector includes a link element which passes across the region of the conjoined ends of the first and second heating elements.

15. A heater as claimed in claim 14, wherein the link element passes over the region of the conjoined ends of the first and second heating elements.

16. A heater as claimed in claim 14, wherein the link element passes under the region of the conjoined ends of the first and second heating elements.

17. A heater as claimed in any one of claims 13 to 16, wherein the radially inner portion of the second electrical connector extends substantially at 45 degrees to a portion thereof passing through the terminal block.

18. A heater as claimed in claim 9, wherein a radially inner region of the second electrical connector extends generally circumferentially of the heater in a direction away from the terminal block.

19. A heater as claimed in claim 18, wherein the radially inner portion of the second electrical connector extends substantially at 45 degrees to a portion thereof passing through the terminal block.

20. A heater as claimed in claim 18 or 19, wherein the radially inner portion of the third electrical connector

includes a link element which passes across the second heating element.

21. A heater as claimed in claim 18, 19 or 20, wherein the radially inner portion of the first electrical connector includes a link element which passes across the second heating element.

22. A heater as claimed in any one of claim 1 to 8, wherein the first electrical connector is positioned intermediate the second and third electrical connectors.

23. A heater as claimed in claim 22, wherein a radially inner region of each of the second and third electrical connectors extends generally circumferentially of the heater in a direction away from the terminal block.

24. A heater as claimed in claim 23, wherein the radially inner portion of the second electrical connector extends substantially at 45 degrees to a portion thereof passing through the terminal block.

25. A heater as claimed in claim 23 or 24, wherein the radially inner portion of the third electrical connector extends substantially at 45 degrees to a portion thereof passing through the terminal block.

26. A heater as claimed in claims 23, 24 or 25, wherein a radially inner region of the first electrical connector extends generally circumferentially of the heater in a direction towards one of the second and third electrical connectors.

27. A heater as claimed in claim 26, wherein the radially inner region of the first electrical connector extends substantially at 80 degrees to a portion thereof passing through the terminal block.

28. A heater as claimed in claim 1 and substantially as hereinbefore described with reference to Figures 1 to 3 or Figure 4 of the accompanying drawings.

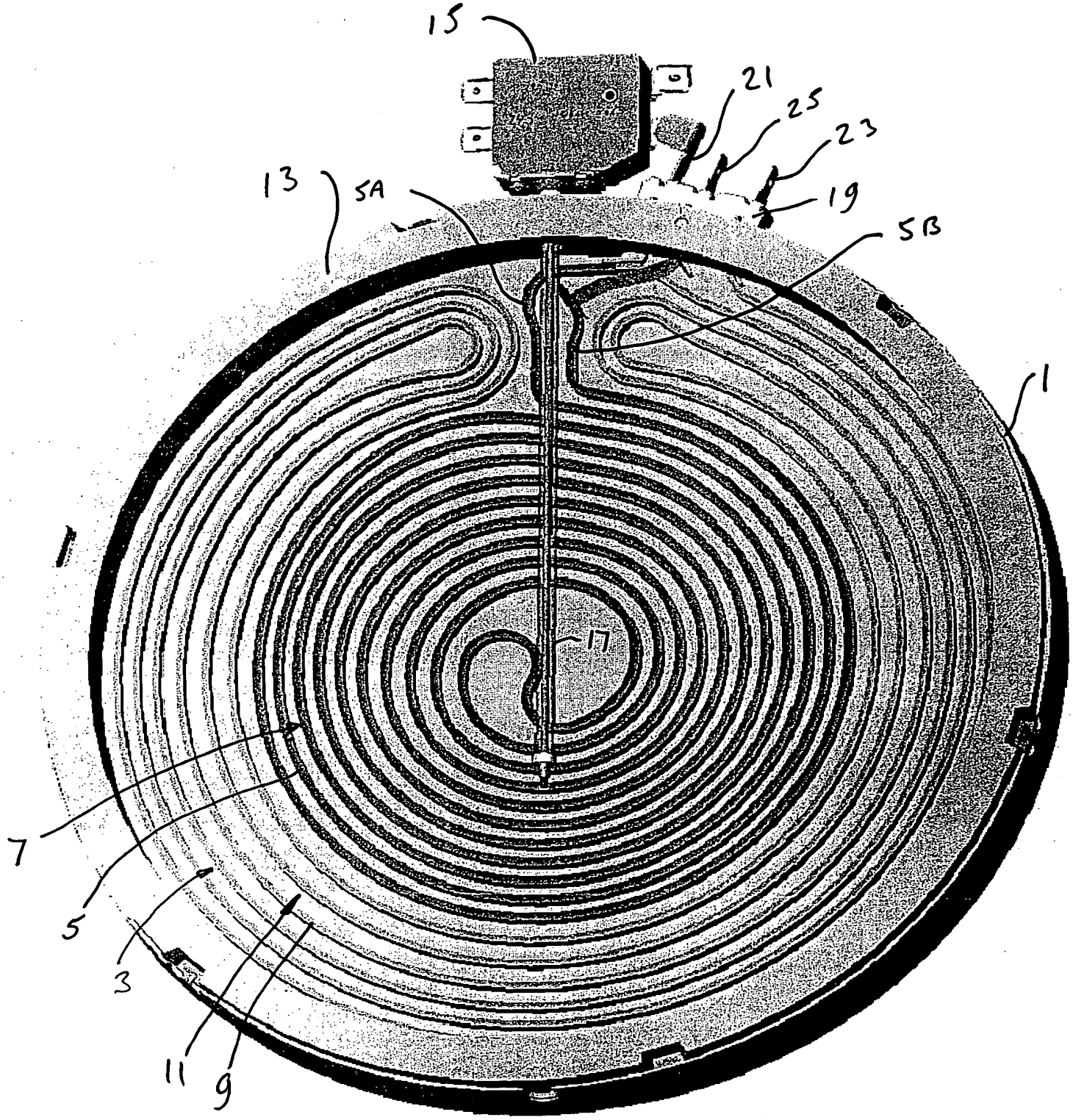

Fig. 1

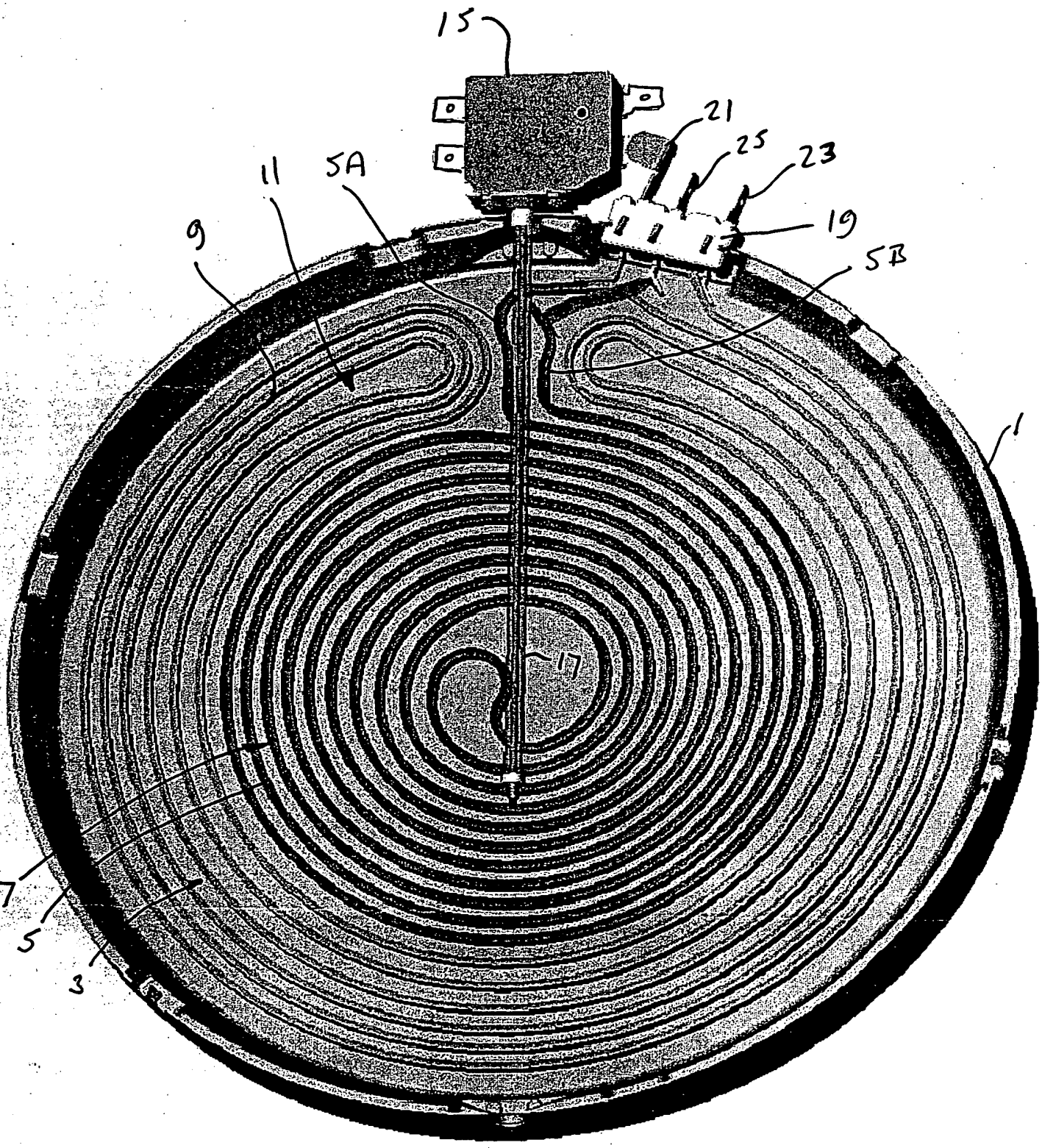

Fig. 2

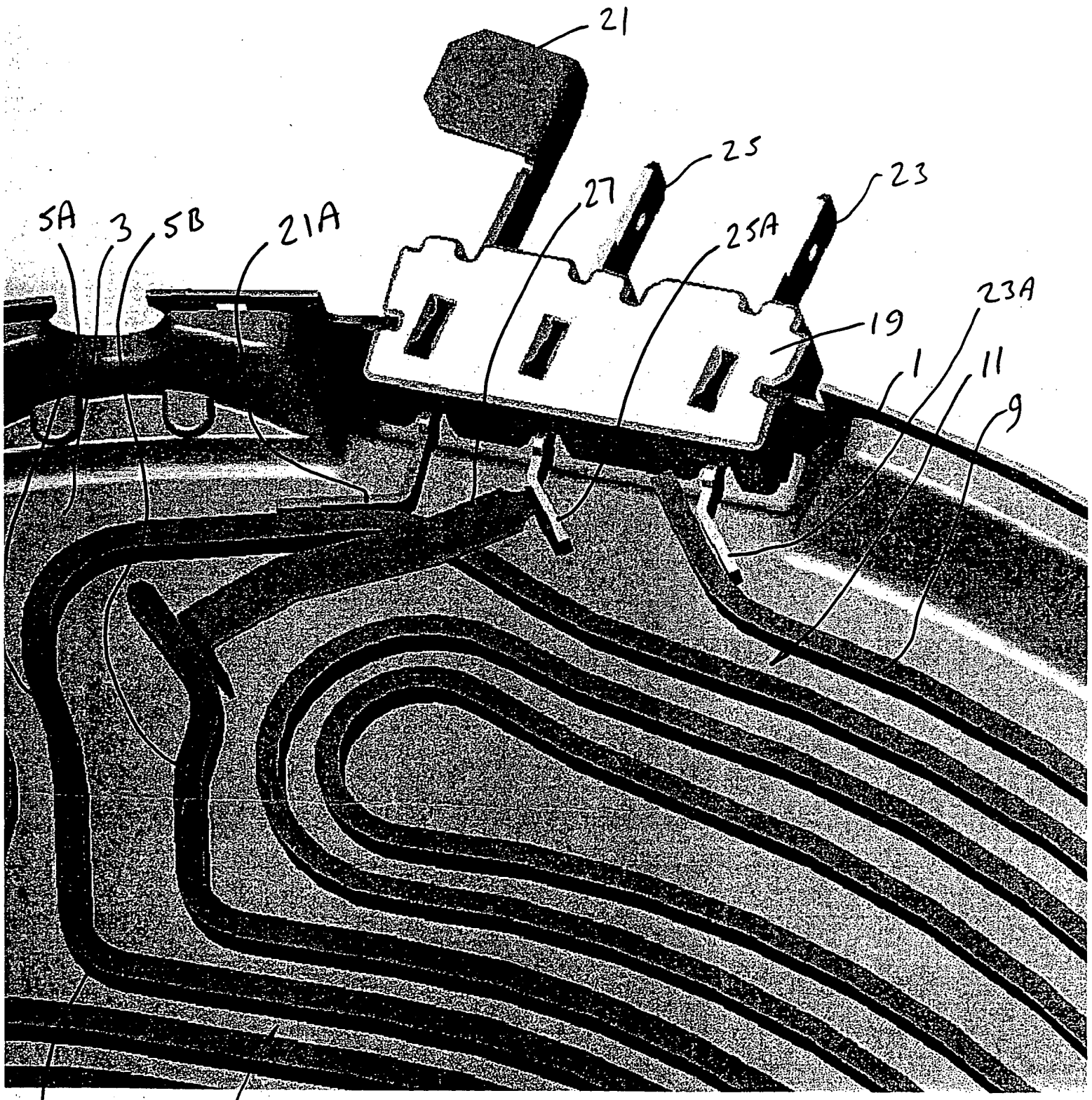

Fig. 3

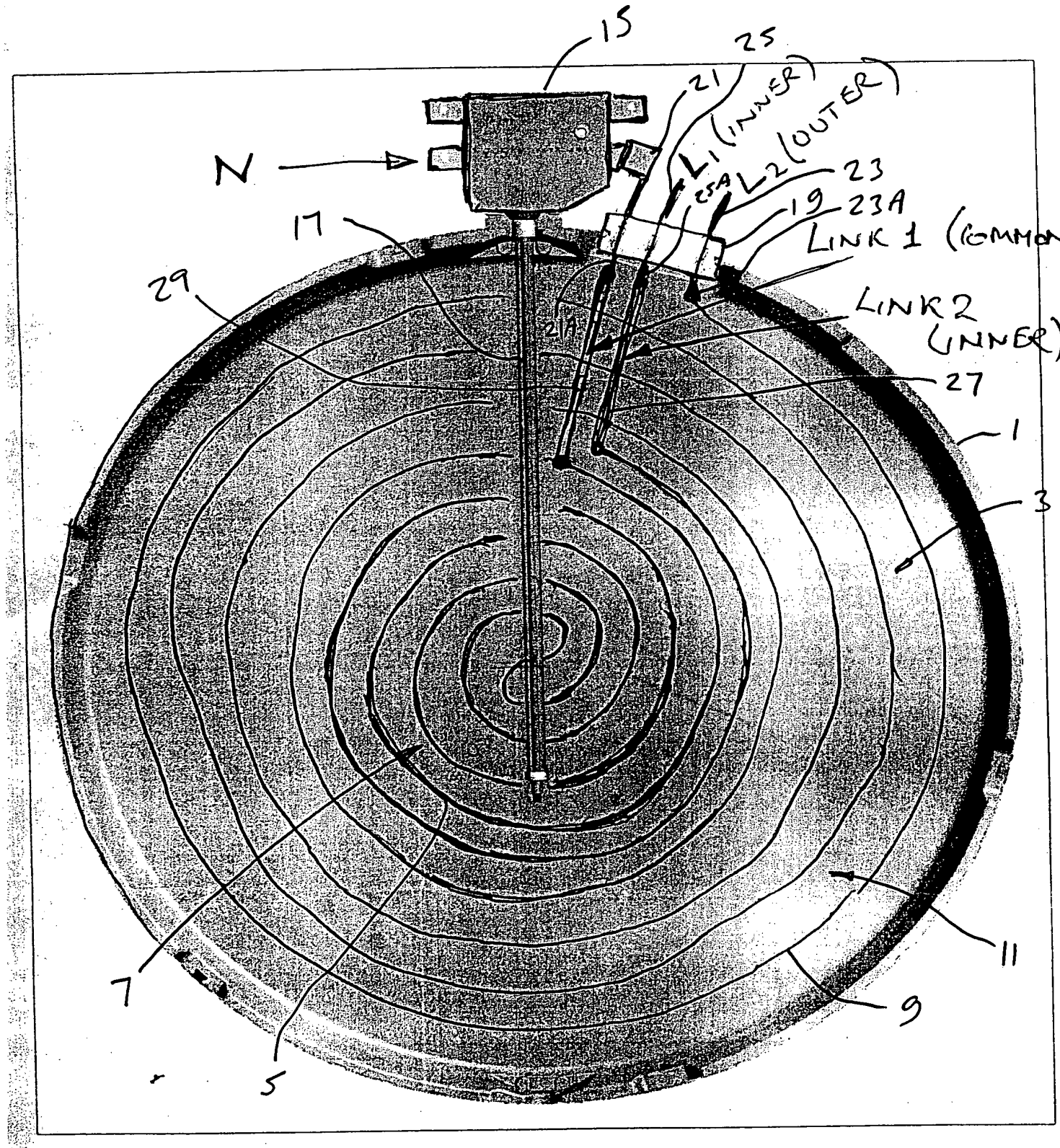

Fig. 4